

## Children with Mild and Unilateral Hearing Impairment

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### Introduction

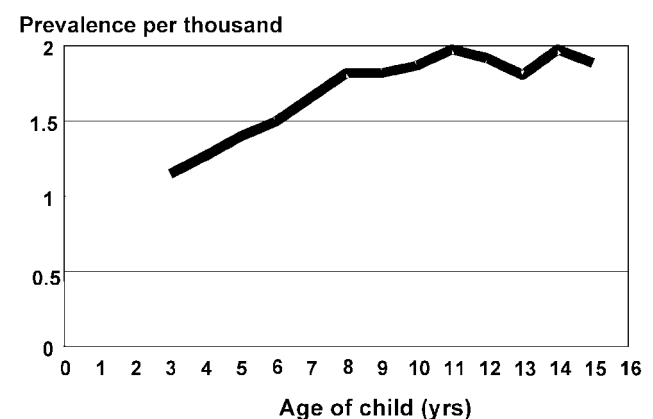
In the UK, children with mild and unilateral hearing impairment represent an under-reported and under studied group. The majority of surveys to date have covered only children with bilateral losses greater than 40 dB HL. It is only in the past few years, with the work of researchers like Bess, Dodd-Murphy and Parker (1998) that moves have been made to identify this group as early as possible, and to provide intervention. The Bess et al. study showed a prevalence of unidentified minimal sensorineural hearing impairment among 3rd, 6th and 9th graders of 5.4%. This figure, while seeming high, includes unilateral high frequency minimal losses that were by far the most commonly occurring. The study found consequences to even a minimal loss: these children were three times more likely to be kept back a grade in school, and to see themselves as socially separate from their peers. With the advent of newborn hearing screening, it has become possible to identify these children within the first months of life, and the screening programmes in the states of Colorado and New York aim to find all children with any degree of hearing impairment, regardless of how slight.

As the UK has a government funded health system, there is a requirement for rigorous evidence-based medical research before any such major changes to the current system can be made. To this end, this paper reports on work being done as part of a doctoral study investigating the impact of a mild or a unilateral hearing impairment on the quality of life for the child and their family, as well as the current service provision and management options for these

children. In order to plan for implementation of service provision for children with a mild and unilateral hearing loss, we need to establish at the outset the approximate population size, and prevalence figures for these groups.

### Epidemiology

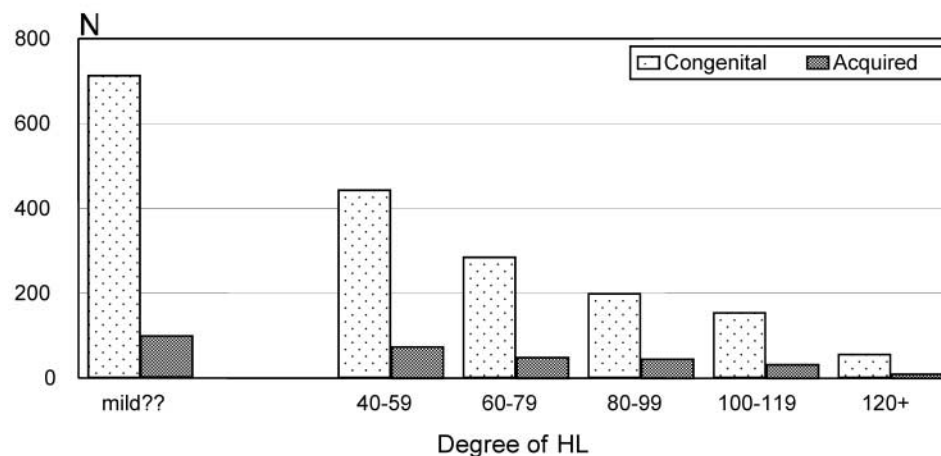
The prevalence of children born with a permanent bilateral (i.e. 40 dB HL in the better ear) is approximately 1.1 per 1000. A further one to two children per thousand may also have a deafness that causes some harm (Fortnum, Summerfield, Marshall, Davis and Bamford 2001). Figure 1 shows the prevalence per thousand of deaf and hearing impaired children in the UK by age, from a nation-wide study of support options. The graph clearly shows an increase in the numbers of hearing impaired children as the age of the children rises. There are various possible



**Figure 1.** Prevalence from UK study of support options for deaf and hearing impaired children (Hearing loss >40 dB HL, bilateral) as a function of age. N~ 18,000

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**Figure 2.** Number of deaf children in 20 dB categories  $n = 1602$  born 1985–1995, and aged ~5yrs together with an estimate for the number of mild impairments there might be in Trent and NW region.

explanations for this. The rise may be due to new cases – that is, acquired hearing losses that were simply not present in the earlier years of life. It may also be that previously ‘mild’ cases have worsened to such a degree that the hearing impairment now passes the 40 dB HL mark. A similar pattern may happen with unilateral losses: the ‘better’ ear may also deteriorate and thus increase the prevalence of bilateral losses. Some of the effect may also be due to persistent cases of Otitis Media with Effusion (OME) that can cause long-term hearing loss.

Figure 2 shows the numbers of deaf and hearing impaired children in the 1985–1995 birth cohort in the Trent Region of the UK, broken down into 20 dB bands. From the figures and the curve obtained, a prediction has been made as to the possible numbers of mild losses that have not so far been sought out or identified. There are perhaps as many as 700 children with a mild hearing impairment in this birth cohort with this level of hearing loss.

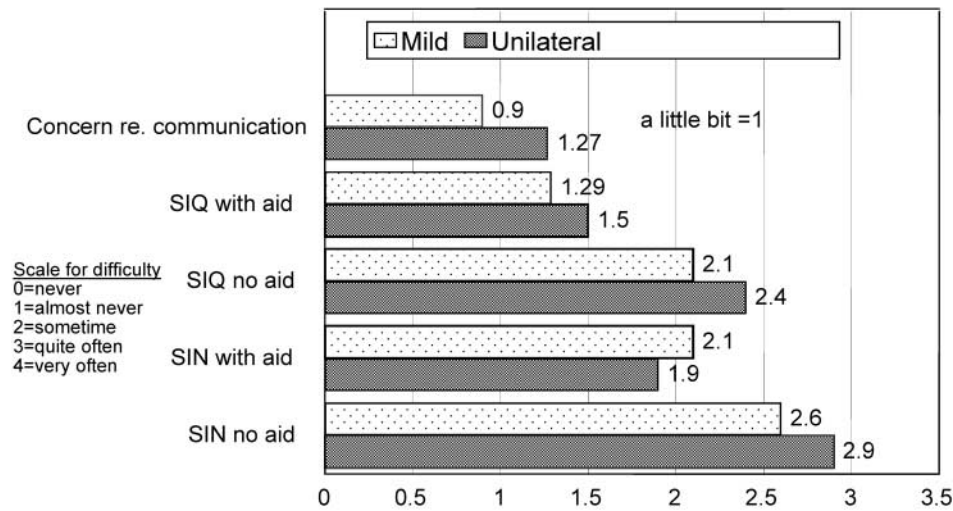
A questionnaire to heads of audiology departments in the UK (Reeve, Davis and Hind 2001) attempted to ascertain the numbers of mild and unilaterally hearing impaired children seen by clinicians within a twelve-month period. A mild impairment was defined as bilateral, sensorineural and between 20 and 40 dB HL. The 56 clinicians who replied to the questionnaire had seen a total of 1220 mild cases within the specified time period: this represented an average of four percent of their total caseload. The same clinicians had seen only 443 unilaterally hearing impaired children (this was defined as being permanent, sensorineural and in one ear only). These

children comprise only four percent of the total caseload. When these figures are compared with the population estimates from figure 2, it can be concluded that large numbers of children with mild and unilateral hearing losses are not finding their way into professional audiology clinics and are not obtaining any sort of management or help from services.

### Impact of a Mild or Unilateral Hearing Impairment

Before it can be concluded that this is therefore a problem that needs to be ‘solved’, there is a need to analyse the current situation of children with a mild or a unilateral hearing impairment and see how – if at all – this degree of hearing impairment impacts on the quality of life (QoL) for the child and their family.

To accomplish this, a questionnaire survey was sent out to 150 families of children with either a bilateral mild or a unilateral hearing impairment. The questionnaire itself was developed from previous QoL questionnaires devised at MRC Institute of Hearing Research for use with moderate, severe and profoundly hearing impaired populations. The families receiving the questionnaire had all been seen at the Children’s Hearing Assessment Centre (CHAC) in Nottingham. Types of losses included both conductive and sensorineural, as the study wanted to discover possible differences between permanent and transient impairments. Almost a third of the hearing impaired children in the families surveyed had additional disabilities, with Downs Syndrome being the



**Figure 3.** Parental concern for overall communication, and ease of listening in quiet and noise, with and without an aid.

most common. It is a reasonable hypothesis that for most of these children, the assessment of the additional disability was the route by which the hearing impairment was discovered.

Forty percent of the questionnaires were returned: there may have been a bias to those parents who had had more involvement with the audiological services being more inclined to help with the study and complete the form. This information was combined with audiology notes for 95 children with a mild hearing impairment, of whom 39 provided data from the questionnaire; and 58 children with a unilateral hearing impairment (worse ear >40 dB HL, and with a minimum 15 dB HL asymmetry), of whom 27 responded to the questionnaire.

It was hypothesised that there would be two main areas where the hearing impairment would affect the child and family's quality of life: hearing-specific consequences, and wider knock-on effects. The first area would include aspects such as locating and orienting sounds in space: this would obviously be particularly impacted for children with a unilateral hearing impairment. Hearing speech in both quiet and noise could also be a major difficulty for both groups of children.

To assess the second, wider impact, the questionnaire covered areas such as the child's educational progress, their speech and language development, and how the hearing impairment affected the types of activities the family carried out together, as well as asking about the overall impact on the quality of life

for the child and the family.

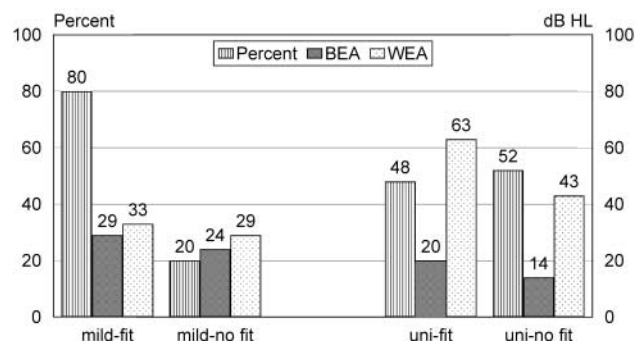
The possibility of a mild or unilateral hearing impairment affecting the child's IQ also needs to be considered although this cannot be easily assessed through a questionnaire. An earlier study by Davis and Hind (1999) found that a group of children with a moderate to severe permanent child hearing impairment (PCHI) had a large gap of twenty four IQ points below the normally-hearing control group. This pattern was not seen in children where

the impairment was due to otitis media, and begs the question as to where on the scale would one find children with a mild or a unilateral hearing impairment. Would they behave more like the children with transient hearing loss, and show very little deficit in IQ, or would they show a similar pattern to the permanent, more severely hearing impaired group? It is hoped that a planned doctoral study, which will involve various tests of speech and language, and intelligence on a small group of mild and unilaterally hearing impaired children, to be carried out within the next six months, will go some way toward answering this.

### Impact on Speech and Language

Forty-four percent of the parents of a child with a mild hearing impairment, and forty percent of the parents of a child with a unilateral hearing impairment reported that their child had more difficulties saying certain speech sounds than they would otherwise expect. A non-significant, but high proportion of parents (fifteen percent for mildly hearing impaired children, twenty two percent for unilaterally hearing impaired children) reported that it was "often" or "very often" difficult to understand their child. There are no similar data on children with a greater degree of hearing impairment, so we are unable to make comparisons here.

A section of questions focusing on communication asked how difficult it was for the child to listen in quiet and noisy situations, with or without their

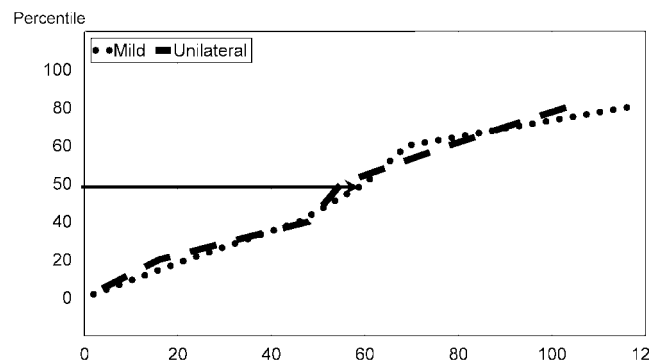


**Figure 4.** The percentage of children seen at CHAC in Nottingham who were fitted with hearing aids as a function of mild or unilateral impairment with degree of impairment in better (BEA) or worse (WEA) ears.

hearing aid if appropriate. Very little concern about overall communication was reported: the average response was a numerical value of 0.9 for children with a mild loss, and 1.27 for the unilateral group: the response was scored as 0 for “no concern”, and 1 for “a little bit”. The difference between the two groups is non significant. Figure 4 shows the breakdown for parental rating of their child’s ability to hear in quiet and in noise, with and without an aid. There is no significant difference between the two settings: the presence or absence of noise does not make a difference to the child’s ability to hear for these cases. However, the provision of a hearing aid does indeed make a significant difference ( $p < .01$ ) to the ease of listening, and it is worth considering how many of these children are given amplification and, if so, at what age.

## Amplification

Figure 4 shows the percentage of children from the overall survey fitted with amplification, further broken down by better ear average (BEA) and worse ear average (WEA). The graph shows no significant difference in the ear average for the children with a mild hearing loss – the decision to provide amplification was probably made on criteria other than the audiogram, such as parental desire. A high proportion of children (80%) were aided: this is an area that shows great variation across the UK, and major uncertainty in clinical practice (see Reeve et al. 2001). For the unilateral group, those who were aided are children showing a greater degree of loss in the impaired ear.



**Figure 5.** Age (in months) of fitting of hearing aids at CHAC, Nottingham, for children with a mild or a unilateral impairment.

Figure 5 shows the average age of aid fitting for children with a mild or unilateral impairment at CHAC in Nottingham. It takes until the child is aged five years to reach the fiftieth percentile (i.e., half of the children being fitted with hearing aids). This is most likely in the main part due to late identification, as well as ‘watchful waiting’ as a management option by the clinicians. Reeve’s (Reeve et al. 2001) questionnaire to audiologists found that the age of referral for children with a mild or a unilateral hearing impairment to clinics across the UK is between 4 and 6 years. With recent work from Yoshinaga-Itano, Sedley, Coulter and Mehl (1998) showing the benefits of early identification, it is clear that there is room for much improvement here. The issues of early identification through newborn hearing screening will be addressed later in this paper.

Once amplification has been fitted, there is still the question of acceptability and use. The parents who responded to the questionnaire survey reported that 50% of the children with a unilateral hearing loss who had received an aid “never” wore it now, with 26% wearing it “all of the time” and 4% “only for school”. The pattern for children with a mild impairment was somewhat different, with a greater frequency of aid use: 44% wore it “all of the time”, and 3% “only for school”. Still almost a quarter of children with a mild impairment who had been given an aid, “never” used it. The main reason given for this from the parental comments was because of the associated stigma, and bullying that having a hearing aid invites.

## Effects of a Mild or Unilateral Hearing Impairment on Quality of Life

The impact of the hearing impairment on the quality of family life was measured by aggregating responses to the following question: "Does having a hearing impaired child affect your family life in the following areas?"

- Family activities and outings
- Seeing friends and relations
- Relationships
- Health (includes stress)
- Employment opportunities
- Income and earnings
- Time spent with child
- Other.

The allowable responses were given on a five-point scale ranging from "no effect" through "very small" and "small" to "quite big" and "very big" effect.

Table 1 shows the responses from the various quality of life measures compared with data from previous MRC Institute of Hearing Research studies, which asked the same question of families where the child's hearing impairment was greater. The numerical score is a linear conversion of the five-point response scale in the questionnaire, where a score of zero is "no effect at all" and a score of four, "very great effect." The effect on quality of family life does indeed lessen with the severity of impairment; however, the score is still a high one, and does not mean that a mild loss has minimal impact.

Breaking down the results within those categories, the highest impact was on the health of the family, with significantly more responses towards the "small" and "quite big" end of the scale. None of the questionnaire respondents reported any effect of the hearing impairment on seeing friends and relatives, employment, and income.

The questionnaire also asked about the impact of the hearing impairment on the quality of life for the child. Questions included: "How much does your child's hearing impairment affect their everyday life" (five-point response scale) and "If your child has medical problems or disabilities (other than their hearing impairment), how much does this affect their everyday life?" (with the same five-point response scale). Other items covered whether the parents felt that their child was clumsy, and inquired about any accidents that may have kept the child away from school in the last six months.

The majority of parents felt that the mild or unilateral hearing impairment did not have a great impact on their child's life. Exactly one third of the respondents (20/60) stated that the impact was "very little" or "not at all", with another third using the "not too much" category. The second column of table 1 gives the scores along with those for other degrees of hearing impairment. There is a significant difference between the ratings from parents of children with a mild or a unilateral impairment, and those where the impairment is greater.

The question on clumsiness showed a significant difference between the children with a unilateral hearing loss and those where, regardless of severity, the loss is bilateral. The data are in the third column of table 1. The difference in responses was significant

**Table 1.** Scores on several quality of life measures as a function of hearing impairment. Note that the average age is not equal for all groups, being thirteen for the mild and unilateral groups and eight for the others.

Type of Loss	Impact of hearing impairment on quality of family life score.	Parental rating of the impact of hearing impairment on the quality of life for their child.	Child's clumsiness as rated by parents. <i>Note the significant difference between the unilateral group and the mild group.</i>	Effect of the child's behaviour, communication, independence and education on the family
Mild	10.6	1.4	23	9.2
Unilateral	10.1	1.5	48	9.7
Moderate	12.0	2.0	33	9.4
Severe	13.0	2.4	31	11.7
Profound	15.0	2.8	33	11.8

between the mild and the unilateral groups, and just short of significance between other bilateral hearing impairments.

A final group of questions asked about which specific areas of the hearing impaired child's life have had an impact on the family: their communication, behaviour, independence and education. Responses were on a five-point scale, from "no effect", through "very small effect" "small effect" to "quite big" and "very big" effect. There were no significant differences between responses to the areas, although a wider range, and a greater impact was had by the child's behaviour, and education. When the results from these groups are aggregated, and then compared with the findings from earlier studies on more severely hearing impaired children, it can be seen from the figures in the fourth column of table 1 that there is no difference between the impact on the family for a child with a mild or a unilateral impairment than if the child has a moderate hearing loss.

For all these comparisons by severity of hearing impairment, it must be noted that the average age of the children in this study, with a mild or a unilateral hearing impairment was thirteen years, whereas the children with moderate, severe and profound impairments, who had been surveyed were, on average, aged eight years. This five year gap may make a difference to some aspects of quality of family life: certain aspects of life may be easier with an older child, or, alternatively, as the child grows and wants to be more independent, areas which were not a problem before may become so.

## Identification

This difference in the average age between the mild/unilateral children and the children with more severe hearing impairments may well be due to the fact that children with mild or unilateral hearing impairments are identified significantly later, often not until they are starting school and beyond.

Data from CHAC show that of the small numbers in each group who were screened neonatally, half of the children passed it. Nottingham Health Authority has been using targeted neonatal screening. Similar numbers passed the Infant Distraction Test (IDT): 27 out of 52 (52%) children with a mild impairment and a worse ear average of 32 dB HL. For the unilateral group, 16 out of 30 (53%) of children passed the IDT; their worse ear average was 50 dB HL. If these children are to be picked up through screening, either at

the neonatal stage or at school entry, the sensitivity of the screen will have to be set low enough to pick up 20 dB HL losses.

Parental concern is of course a relevant factor in identifying hearing impairment, although responses to the Quality of Family Life questionnaire show that only a third of parents whose child had a mild hearing impairment thought that there may have been a problem before the professionals told them: for unilateral impairments, half the parents suspected something was wrong.

A third possible identification route is that of professional concern. Teachers may notice a change in behaviour, or low performance at school. Speech and language therapists are also trained to refer a child with language or phonology problems to have their hearing assessed. However, the easiest and most effective route would be through a programme of Universal Newborn Hearing Screening, as this is currently being implemented in England.

## NHS Newborn Hearing Screening

England is in the process of implementing Newborn Hearing Screening as part of the National Health Service. Parents need to be able to establish good and effective communication with children from the earliest opportunity. In order to enable this, the proposed screening programme aims to identify children born with moderate, severe and profound deafness at the most appropriate time, and introduce support packages at the most effective time.

The currently planned approach for babies found with a mild hearing impairment is to keep them under audiological surveillance and follow them up after twelve months. The cut off for the neonatal screen will be 40 dB HL, so these children will officially "pass" the screen. However, if there are any aspects such as family concern, no clear response on one ear from the ABR, or other criteria, then follow-up will occur earlier. The cost-effectiveness of this wider follow-up procedure will be monitored, and reported upon in due course. Children identified as having a unilateral hearing loss will be picked up by the screen and referred for audiological management at the earliest possible opportunity.

There is still a lot of uncertainty about neonatal screening for mild impairments. The first question is whether these impairments should indeed be detected within the first weeks of life, and if so, by what methodology. The second concerns the need to

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obtain scientifically based evidence as to the best support package for management. The most effective and timely use of health, education, and social services for infants with a mild-moderate impairment identified in the first few months of life by neonatal screening needs to be assessed, and guidelines provided.

Detecting mild impairments requires instruments of high enough sensitivity to pick up this slight degree of loss, without creating too many “false negatives” and so give unnecessary alarm to parents whose child does in fact have no hearing impairment.

Potential methods include Transient Evoked Otoacoustic Emissions (TEOAEs) and Distortion Product Otoacoustic Emissions (DPOAEs), which are possibly sensitive enough, and could be used to prioritise follow-up or child health surveillance. Automated ABR could be set at such a level as to pick up losses of 20 dB HL, but the difference that this will make is not yet known.

However, evidence from focus group meetings carried out by MRC Institute of Hearing Research shows that parents want to know as early as possible if their child has a hearing impairment, regardless of degree. There is a definite need to have a habilitation plan for this group, and a need to monitor them for any progressive loss. There may be a genetic risk factor associated with mild or unilateral hearing impairment, and referral for genetic counselling may be advised. However, once they have been identified, the best course of management for these children is still undetermined.

## Interventions for Children with Mild to Moderate Hearing Impairments

The most rigorous way to obtain information on management benefits for children with a mild-moderate hearing impairment, identified through neonatal hearing screening, is by conducting a randomised controlled trial. Funding has been obtained by MRC Institute of Hearing Research to carry out such a study, and focus groups have been conducted with professionals and parents in order to identify the most effective way to develop a final protocol.

Intervention for these children, once identified, can be broken down into four main areas:

Firstly, the need for family support must be considered. This may be linked in with education, and would require a key worker for the family, to provide

appropriate information and support. Secondly, there is the need for ongoing assessment and review. This is primarily audiological, to monitor the child’s hearing for any progressive loss, but also includes diagnostic and medical reviews and education. Communication is a third factor that must be considered. The family need specialised guidance and support to encourage early communication, and speech and language development. Finally, management choices, particularly in the area of amplification must be determined. Individual hearing aids are the most likely option, but alternatives could also include sound field amplification, or provision of FM aids.

In order to provide best practice in the area of amplification, we still need to know the most appropriate time to provide hearing aids for children with a mild or moderate hearing impairment; the best aids and the best fitting strategy for them, and the best and most sensible ways to assess the benefits of aiding for these children. This information is obtainable through a controlled study, in which children are allocated to different (but acceptable) groups, with aids provided at different ages, and the benefits assessed at key stages throughout. Consideration also needs to be given as to a means of assessing which children with a mild loss would be appropriate candidates for amplification.

However, there are ethical questions to be asked about the acceptability of randomisation in such a trial. Can children be systematically allocated to receive intervention at different times? If the other three areas detailed above are all in place, would that then make a delay in amplification more acceptable? And finally, what range of hearing should be included in this study? Preliminary focus groups report that parents would prefer to have intervention as soon as possible after identification of the hearing impairment, and many professionals would also see a delay in providing amplification as unethical.

If amplification is provided to this group of children at an early age, a definite schema is needed in order to assess the benefits. Possible areas to include are:

- Acceptance of amplification
- Use of amplification
- Development of speech, language and communication
- Quality of life for the child, and
- Quality of family life.

The assessment of the success of the overall outcome would cover such aspects as the knowledge of the family and child about the hearing impairment and how best to manage it. The amplification areas mentioned above would play a key role also. The question as to how long to follow up and monitor these children is yet to be resolved: whether it should be continuous, or at key stages is not yet known. Nor is the number of years for which this should take place. The benefits from receiving early intervention may well be those that only accrue over time.

## Summary and Conclusions

Major uncertainty still surrounds the aspects of best practice and management for children with mild or unilateral hearing impairment, and there are no definitive answers as yet. The exact prevalence is unknown, but could be high: perhaps doubling the number of hearing impaired children, as was found by Bess et al. (1998) in his systematic audiological testing of children in school grades. There is also the possibility that children identified as having a mild or a unilateral impairment could be in a high-risk group for progressive deafness.

Currently, between five and ten percent of the clinical caseload of audiologists in the UK is mild and unilateral children. The impact of this type of loss is mostly less than for children with a moderate impairment, but is still severe, and still causes concern for their families.

These children with a mild or a unilateral loss do indeed need to be identified, but the benefits of early as opposed to later identification have yet to be scientifically studied. Any interventions need to be family friendly, meeting the individual needs of each child and their family. Amplification when the family is willing to accept would seem to make a difference in speech perception, with particular attention paid to

high frequencies. It is hoped that a randomised controlled trial will provide more answers as to the best management practices, particularly when linked with the possibilities for early identification offered by newborn hearing screening.

## Acknowledgements

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